with the Hydrographer's Office of the United States, so that the united labours of the two greatest naval and commercial nations of the world may be combined, with the least practicable delay, in promoting the interests of navigation.

The President and Council refer to the documents which have been submitted to them, and more especially to the "Explanations and Sailing Directions to accompany wind and current charts" prepared by Lieutenant Maury, for a more detailed account of this system of cooperative observations, and of the grounds upon which they have ventured to make the preceding recommendations.

(Signed) S. Hunter Christie, Sec. R.S.

H. U. Addington, Esq.

3. "Second Appendix to a paper entitled 'Discovery that the Veins of the Bat's Wing (which are furnished with valves) are endowed with rythmical contractility.'" By T. Wharton Jones, Esq., F.R.S. &c.

The author states that, from a microscopical examination of the blood-vessels and circulation in the ears of the long-eared bat, he has ascertained that, different from what he had discovered to be the case in the wings, the veins of the ears are unfurnished with valves, and are not endowed with rythmical contractility, and that the onward flow of blood in them is consequently uniform.

4. A paper was in part read, entitled, "Upon the Morphology of the Cephalous Mollusca, as illustrated by the anatomy of certain Heteropoda and Pteropoda." By Thomas Huxley, Esq., F.R.S. Received March 18, 1852.

May 27, 1852.

The EARL OF ROSSE, President, in the Chair.

The reading of Mr. Huxley's paper, "Upon the Morphology of the Cephalous Mollusca, as illustrated by the Anatomy of certain Heteropoda and Pteropoda," was resumed and concluded.

In the present memoir the author endeavours to determine, upon anatomical and embryological grounds, the true homologies of the different organs of the Cephalous Mollusca, and thence to arrive at some idea of the archetypal form, as definite modifications of which the existing molluscous forms may be considered to have arisen.

The Pelagic Heteropoda and Pteropoda, from their small size and extreme transparancy, are peculiarly favourable subjects for the anatomical part of this investigation, and it is from a detailed examination of those systems of organs which are of importance for the purpose that the author deduces the following conclusions:—

1. In the *Heteropoda* the intestine is bent towards the dorsal or *hæmal* side in consequence of the development behind the anus of the visceral "hernia," which is therefore called a *post-abdomen*.

2. In the *Heteropoda*, the "foot," in its most perfect condition, consists of three portions, a *propodium*, *mesopodium* and *metapodium*.

3. The *Heteropoda* are more or less prosobranchiate, the degree depending upon the amount of development of the post-abdomen.

4. In the *Pteropoda* the intestine is bent towards the ventral or *neural* side, in consequence of the development of the visceral "hernia" in front of the anus. It is therefore called an *abdomen*.

5. In the *Pteropoda*, the foot, besides the parts mentioned above, possesses an additional appendage, the *epipodium*, which forms the expanded wing characteristic of the group.

6. The *Pteropoda* are opisthobranchiate, prosobranchiate, or intermediate in character, according to the degree of development of the *abdomen*.

The *Heteropoda* and *Pteropoda*, then, may be considered to represent two opposite phases of the modification of the molluscous archetype.

In the second part of the paper, the author endeavours, by carefully collating the known facts of the development of the Mollusca, to ascertain (*a*) the primary form of all cephalous Mollusca, and (*b*) the mode in which, in the course of development, this embryonic form becomes metamorphosed into the adult form; in order, if possible, to account, on the safe basis of ascertained morphological laws, for the peculiar modifications of structure which have been found, anatomically, to obtain among the Heteropoda and Pteropoda.

He finds that it is possible not only to deduce the structure of the Heteropoda and Pteropoda from a simple and symmetrical archetype by such morphological laws, but that all the cephalous Mollusca fall under one or other of the great types of which these have been taken as exemplifications.

After a discussion of the various theories of the homology of the organs of cephalous Mollusca proposed by Loven, Leuckart, &c., the following general conclusions are set forth:—

1. The cephalous Mollusca are all organized after the same fundamental form or archetype.

2. The arrangement of the systems of organs within this archetype is essentially the same as in the Vertebrata and Annulosa; that is to say, supposing the digestive system to form the axis of the body, the nervous centre lies on one side of that axis; the blood-vascular centre upon the opposite; and furthermore, the archetype is symmetrical with regard to a longitudinal vertical plane, passing through these three.

3. The *molluscous* archetype differs from the *vertebrate* in the circumstance—1, that the mouth opens upon the neural surface; 2, that the embryo commences its development upon the hæmal side.

It differs from the *articulate* archetype in the latter circumstance, and from both in the fact, that the proper appendicular system (represented by the epipodium) is almost rudimentary, and that the locomotive function is mainly performed by a development of the neural surface.

4. The process of concentration and fusion of parts by which the

principal modifications are produced among the Vertebrata and Articulata, seems almost absent in the Mollusca; the changes among them being produced by an asymmetrical development of the primarily symmetrical archetype, a process comparatively rare among the Articulata and Vertebrata.

5. The part thus asymmetrically developed is invariably a portion of the hæmal surface, and may be called an *abdomen* or a *post-abdomen*, according as it is placed before or behind the anus.

6. The intestine is found to be bent in two directions among the Mollusca, hæmad or neurad, and these flexures correspond with the development of a post-abdomen or abdomen, respectively.

7. The process of development demonstrates that the Tectibranchiata, Nudibranchiata and Pectinibranchiata (in part at least) belong to the former division, and that the Cephalopoda and Pulmonata belong to the latter.

8. Anatomical evidence shows that the Heteropoda have a hæmal flexure of the intestine, the Pteropoda a neural flexure; and it is almost certain that when their development is traced, the former will be found to have a post-abdomen, the latter an abdomen; there will then be two great divisions of the cephalous mollusca.

a. Those which develope an abdomen:—*Cephalopoda, Pteropoda, Pulmonata.*

b. Those which develope a post-abdomen:—*Heteropoda, Pectinibranchiata, Tectibranchiata, Nudibranchiata.*

9. Prosobranchism and Opisthobranchism may occur as secondary results of either course of development.

10. The principal nervous centres are similar in number and position throughout, and differ only in their arrangement and degrees of concentration. The amount of the latter does not correspond with the complexity of organization of the mollusk, but rather the reverse.

11. The organization of the vascular system is equally uniform; its completeness or incompleteness is no mark of complexity or simplicity of the rest of the organization.

12. The cephalous Mollusca are characterized by the possession of a peculiar organ, the dentigerous "tongue," whose mode of action resembles that of a chain-saw.

13. The locomotive apparatus, when fully developed, consists of four parts, the propodium, mesopodium, metapodium and epipodium. These parts are least modified in such mollusks as Atlanta or Pneumodermon; most altered and disguised in such as Cleodora or Octopus.

14. The term "mantle" should be confined to the surface of the *abdomen* or *post-abdomen*, and to the prolonged edges of that surface.

15. It is of great importance to recollect that the "shells" are probably not homologous organs in all the different forms of mollusks.

The shells of Sepia, Spirula (?), Limax, Clausilia and Helix are developed in the thickness of the mantle.

The shells of Nautilus (?), Pectinibranchiata, &c., are developed from the surface of the mantle by a quite distinct process.

Certain curious differences appear to follow the externality or internality of the shell.

An external shell in a mollusk with a hæmal flexure, *e. g.* Atlanta, has its columellar axis *below* the aperture.

An external shell in a mollusk with a neural flexure, *e. g.* Nautilus, has its columellar axis *above* the aperture

An internal shell in a mollusk with a neural flexure, has its columellar axis *below* the aperture, *e. g.* Spirula, Clausilia, Helix.

In the course of the memoir the author incidentally introduces a number of new, and, as he believes, important facts, with regard to the nervous, circulatory and urinary systems; and describes at length the mechanism of the "tongue" and an organ similar to the "crystalline style" of bivalves, found in the Strombidæ.

The following papers were also read:—

1. "On the Change of Refrangibility of Light." By George G. Stokes, Esq., M.A., F.R.S., Lucasian Professor of Mathematics, Cambridge. Received May 11, 1852.

The author was led into the researches detailed in this paper by considering a very singular phenomenon which Sir John Herschel had discovered in the case of a weak solution of sulphate of quinine, and various other salts of the same alkaloid. This fluid appears colourless and transparent, like water, when viewed by transmitted light, but exhibits in certain aspects a peculiar blue colour. Sir John Herschel found that when the fluid was illuminated by a beam of ordinary daylight, the blue light was produced only throughout a very thin stratum of fluid adjacent to the surface by which the light entered. It was unpolarized. It passed freely through many inches of the fluid. The incident beam, after having passed through the stratum from which the blue light came, was not sensibly enfeebled nor coloured, but yet it had lost the power of producing the usual blue colour when admitted into a solution of sulphate of quinine. A beam of light modified in this mysterious manner was called by Sir John Herschel *epipolized*.

Several years before Sir David Brewster had discovered in the case of an alcoholic solution of the green colouring matter of leaves a very remarkable phenomenon, which he has designated as *internal dispersion*. On admitting into this fluid a beam of sunlight condensed by a lens, he was surprised by finding the path of the rays within the fluid marked by a bright light of a blood-red colour, strangely contrasting with the beautiful green of the fluid itself when seen in moderate thickness. Sir David afterwards observed the same phenomenon in various vegetable solutions and essential oils, and in some solids. He conceived it to be due to coloured particles held in suspension. But there was one circumstance attending the phenomenon which seemed very difficult of explanation on such a supposition, namely, that the whole or a great part of the dispersed beam was unpolarized, whereas a beam reflected from suspended